

INTEGRATED COMBAT COMMAND AND CONTROL SOFTWARE UPDATE PROCESS

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“Uncontrolled spiral development is chaos.”

—MG Robert E. Armbruster

Introduction

This article reflects the experience of the Abrams Tank System, Bradley Fighting Vehicle Systems, and the Force XXI Battle Command Brigade and Below (FBCB2) Program Management (PM) Offices as they integrated the FBCB2 software into weapon platforms. Based on lessons learned, the authors propose a process for the Army to integrate software across platforms and systems. Headquarters, Department of the Army is currently developing and assessing system-of-systems management options.

Background

With our current modernization process, a single unit frequently receives multiple, separate, unsynchronized, and chaotic fielding of various new systems throughout the year. Each fielding adversely impacts the unit's immediate readiness. The process of turning in older equipment, drawing new equipment, conducting new equipment training, and becoming proficient with the new equipment is both demanding and time consuming.

Units are further stressed by periodic updates and upgrades to the soft-

ware embedded in fielded systems. In the past, software upgrades were fielded based on their software program development schedule. From the perspective of a single PM, the turmoil may not be readily apparent, but the combined effects among several systems become significant. For example, the software associated with the Abrams tank alone includes the following: its own operating software, the Global Positioning System (GPS), the Single Channel Ground and Airborne Radio System (SINCGARS), Enhanced Position Location Reporting System (EPLRS) radios, and FBCB2. Maintaining compatibility among all of these systems within a given unit is a challenge for each of the PMs. Given the interdependencies among these systems, the Army can no longer afford the time and turmoil involved in fielding and maintaining these stand-alone systems. The Army must shift paradigms from a stand-alone to a system-of-systems approach.

With the advent of digitization and completion of the first series of Force XXI experiments, the PMs for Abrams, Bradley, and FBCB2 recognized that many new or improved integrated combat command and

control (IC3) capabilities are dependent on specific equipment being fielded simultaneously. To maximize warfighting capability, ensure interoperability, and preclude negative impacts to unit readiness, the programmatic and technical changes for both hardware and software must be strictly managed.

The critical role of software configuration management (CM) demands a system be established that effectively and economically controls the interdependencies and relationships among the host platforms and the IC3 equipment. This article examines these issues with regard to FBCB2 and its integration in the Abrams and Bradley Systems—the Team IC3 approach. This approach accommodates both programmed and unanticipated change while minimizing the impact of those changes on the receiving unit. While this approach is in its infancy, it provides a solid blueprint from which the Army can expand to incorporate a holistic system-of-systems approach to post-fielding software upgrades.

Team IC3 selected this approach because it was the best way to integrate the functionality of FBCB2

within the Abrams System Enhancement Program (SEP) and the Bradley A3, both first-generation digitized weapon platforms. Specifically, the Team IC3 approach is designed to accomplish the following:

- Develop and institutionalize a synchronized and disciplined process for fielding planned and unanticipated software and hardware upgrades that affect command and control (C2) capabilities for the Abrams SEP and Bradley A3;

- Ensure the fielded version of IC3 software is interoperable with the latest version of Abrams SEP, Bradley A3, FBCB2, GPS, Internet Controller software and hardware, SINCGARS, and EPLRS system software; and

- Ensure an open system architecture design to facilitate future upgrades and IC3 modules that are planned for the future.

Concept

The IC3 update approach requires the identification and management of a system-of-systems hardware and software digitization package that includes FBCB2, vehicle and platform digitization, related tactical communications, tactical Internet protocols, and Tactical Operations Center C2 systems. Within those packages, changes are implemented via one of two identified paths: the capability upgrade path or the safety upgrade path. The capability upgrade path addresses pre-planned improvements, unanticipated technological advances, and problem fixes not affecting system and platform safety. The safety upgrade path addresses critical safety-of-use related upgrades.

The following summarizes the IC3 process:

- Each of the PMs with their prime contractors have established plans and schedules to update their software and hardware programs per their user-established requirements. Effective implementation of a controlled change process requires a PM to fully understand each IC3 team member's software and hardware upgrade plans.

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Reviews involving PM Abrams, Bradley, Tactical Radio Communications Systems, and FBCB2 and their respective prime contractors are conducted on a biannual basis. Likewise, requirements development must be oriented on digitization packages and involve all of the respective U.S. Army Training and Doctrine Command's Systems Managers (TSMs). As this process matures, it's envisioned that a prioritized list of proposed capability upgrades will be approved by a General Officer Steering Committee (GOSC). Once a digitization package is defined and funded, materiel developers work hand in hand using the established FBCB2 and platform System Integration Laboratories (SILs) to develop the required package items.

- Safety upgrades are exceptions to this process. Safety upgrades address problems that cannot wait for the next scheduled capability upgrade.

- All digitization package changes are coordinated by a tiered CM approach. The CM process is evolving, but as more PMs and Program Executive Offices become involved, this body will become the key controller of established digitization packages. Experience with early management of Embedded Battle Command configuration indicates changes are best implemented at the lowest level.

- The prime contractors for Abrams and Bradley (General Dynamics Land Systems (GDLS) and United Defense Limited Partnership (UDLP) respectively) receive FBCB2, SINCGARS, EPLRS, and GPS software

as government-furnished equipment. The PMs for Abrams and Bradley are responsible for obtaining all of the software updates and changes from the aforementioned PMs and providing them to their prime contractors for integration and testing. Most of the software products undergo independent verification and validation prior to commencing integration efforts. Weapon system prime contractors are responsible for integrating updated software packages into their systems with full C2 system developer support.

- PM, Abrams, Bradley, and FBCB2 participate in a Central Technical Support Facility (CTSF) interoperability certification update upon completing the capability upgrades. The CTSF certifies overall system-of-system software interoperability. This process ensures that all of the software from the respective programs is successfully integrated into the system-of-system software architecture. Safety upgrades will not require full CTSF recertification. Modifications to the safety releases process are sought as appropriate to accommodate both types of changes.

- To maintain control of baseline configurations in the field, GDLS/UDLP incorporates approved FBCB2 software capability upgrades into subsequent programmed system software updates. Coordinated safety upgrades are immediately implemented upon completion of the modified safety release.

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The Road Ahead

The Army's Unit Set Fielding Prime Directive is designed to modernize and field a process that will accommodate the system-of-systems nature of the digital battlefield. The IC3 approach is designed to work within that process and could be expanded to encompass a holistic Army approach to system-of-systems block software upgrades. The goal of this process is to provide the users controlled block upgrades every 12-18 months.

The Army faces daunting challenges in integrating more than 100 systems into this approach. This will require decisions that affect system-of-systems requirements, functionality, capabilities, and Internet protocols. The impact of these decisions on all stakeholders must be considered. As a result, the CM process needs to begin by controlling the required capability for each block upgrade. This top-down perspective will ensure that individual platforms will be built to the same "macro" objective.

Digitization packages will initially be defined jointly by the respective PMs and TSMs and approved by a system-of-systems GOSC, headed by the current system-of-systems manager, the Deputy Chief of Staff for Operations and Plans. The system-of-system software upgrades will need to be resourced in bundles (by package) within the current planning, programming, budgeting, and execution system process. Funding to support this

approach across all platforms and systems must be tied together. The system-of-systems GOSC would conduct annual budget planning sessions to develop or update a 5-year plan that supports fielding by established packages. To address unanticipated changes, resources also will need to be committed to support post-deployment software support.

A key enabler of this effort is the CTSF, which acts as the final certification authority before a block of field upgrades is released. In applying this model to the Army, the need for a "Super" CTSF is a logical corollary to the Team IC3 process. The Super CTSF will be an expanded version of the current CTSF and will be composed of multiple system-level SILs similar to the IC3 approach. Additionally, the Super CTSF will be the focal point of software configuration and digitization architecture, as well as provide a single responsible authority for software integration prior to a block upgrade being fielded to the Army.

Conclusion

The Team IC3 approach is a seamless, integrated process that ensures successful fielding of planned upgrades to IC3 software and accommodates unanticipated software changes while minimizing impacts to unit readiness. Given the challenges facing the Army today in terms of managing the capability growth of its digital C2 systems, this process is adaptable

Armywide. While the Team IC3 approach is not a cure-all for the software upgrade challenges facing the Army, it does provide a blueprint to ensure a solid process for configuration control of system-of-systems acquisition and fielding.

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